BEAR CREEK WATERSHED ANALYSIS

SOILS

CHARACTERIZATION

Introduction

The Bear Creek watershed is located within the Dry Domain, of the Temperate Steppe Regime Mountains Division, of the Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest Province, of the Overthrust Mountains Section, of the Caribou Range Mountains Subsection as outlined in the National Hierarchical Framework for Ecological Units. Descriptions of these different levels of ecological units are found in "Targhee National Forest Subsections and Landtype Associations" (USDA-FS 1998). There is one landtype association nested within the Caribou Range Mountains Subsection identified as High Caribou Mountains-Conifer Forest.

Physiography

The landforms within the watershed consist mainly of foothills, mountains, ridges and basins formed from a series of thrust faults know as the Idaho-Wyoming Overthrust Belt (Harrison et al., 1953). Elevation ranges from 5,600 feet at the mouth of Bear Creek to 9,476 feet at Big Elk Mountain. Aspects are generally northeast and southwest because of the north-south trending strike/dip slopes of the mountain ridges and valleys that were formed from the overthrust (Jobin et al., 1964). Slopes range from nearly level in riparian areas to over 70 percent on mountain sideslopes. Drainage patterns are dendritic with moderate to strong dissection. Some drainages are structurally controlled by bedrock. Many drainages in the watershed are intermittent, however a few perennial streams exist.

Geology

Geological information for the watershed was collected from several publications and maps (Mitchel et al., 1979; Jobin et al., 1964; and Ross et al., 1967). Surficial geology in the watershed consists mainly of sedimentary rocks with isolated areas of volcanic rock. Sedimentary deposits are mainly sandstone, limestone, shale, conglomerate and siltstone/mudstone. Primary geologic formations identified by the Idaho Department of Lands, Bureau of Mines and Geology that formed the mountains and ridges are Wayan Formation; the Gannet Group consisting of Tygee Formation, Draney Formation, Bechler Formation, Peterson Limestone, and Ephriam Conglomerate, Nugget Sandstone, Stump Sandstone and Preuss Sandstone, Twin Creeks Limestone, Ankareh Shale and Thaynes Formation, Dinwoody Formation, Bear River Formation, Wells Formation (Mesozoic Era); and Mission Canyon Limestone (Paleozoic Era). Geology of the drainages consists of stream alluvium and isolated areas of travertine from the Cenozoic Era.

Many ridges and mountain sideslopes in this watershed have exposed bedrock. Some geologic materials such as the Wayan Formation have high natural erosion potential. Others have high mass instability.

Climate

The climate for the Bear Creek watershed is influenced from major topographic features such as the Pacific coast mountain ranges and local mountain ranges. The mountain ranges trend north and south and are almost at right angles to the prevailing eastward airflow, affecting wind, precipitation and temperature patterns. In general, precipitation increases with elevation, but steepness and direction of slope, orientation, height of ridges, direction of prevailing winds and other features also exert considerable control over the amount of precipitation that falls in a specific area. Increased precipitation at higher elevations is considerably greater in winter than in summer. Less than half of the precipitation falls from April through September (USDA, 1990). Orographic lift intensifies precipitation in these mountains. Precipitation ranges from 16 inches at the lowest elevations to 30 inches at the highest. Average annual air temperature is about 38 degrees F (Abramovich, 1998).

Soils

Soils that formed from the geologic materials listed above have high base saturation that provides relatively high natural fertility. Because many of the soils in this watershed formed from geology containing shale and limestone, they have a dominance of clay and silt in the profile. These kinds of soils have high erosion potential and may produce high levels of sediment when erosive conditions occur. This watershed has a majority of soils that formed on unstable landforms (USDA-FS, 1997). For purposes of this characterization, soils are broken into three major landform groupings for simplification. Soils are described in relationship to 1.) mountains and ridges, 2.) basins and foothills, and 3.) drainages.

Soils on Mountains and Ridges

Soils that formed on the mountains and ridges are moderately deep to very deep (20”->60”) with some shallow soils (<20”) located on the ridgetops. Because they formed on steep slopes with sedimentary parent material, erosion potential is high for these soils when they lose their protective ground cover. The potential is also high for mass movement when soils become saturated with water. Some areas of exposed geologic materials on mountain sideslopes have high natural erosion. This type of erosion and mass instability is generally associated with the Wayan Formation (Olson et al., 1970). As these geologic materials weather out and are exposed, they erode down-slope.

Soils on Basins and Foothills

Soils that formed on the basins and foothills are generally very deep (>60”) and are well drained. They are dominantly vegetated with big sagebrush, aspen and mountain shrubs.

They have less potential to erode than those formed on the mountains and ridges because they formed on slope less than 40 percent. Maintenance of ground cover is important to maintain stable conditions. They have high range productivity potential and support a variety of uses including grazing, recreation and wildlife habitat. Because they often have high clay content in the profile, over-use may produce compaction that could lower potential productivity. Erosion from roads in this area is notable because ruts are often formed from vehicles when they are wet and channel sediment into the streams. Road maintenance is often required to reduce these impacts.

Soils in Drainages (Riparian)

Soils that formed in drainages are the most productive in the watershed. They are almost always very deep (>60”) and are influenced by wetness during some period of the year. Riparian vegetation such as willows and sedges grow in most of the drainage soils. Soils in drainages may be affected by grazing livestock and wildlife, recreation, roads and influences from upland conditions. Some soils are susceptible to down-cutting that often lowers the water table. When this occurs, riparian vegetation is gradually replaced by upland species such as sagebrush. Most riparian soils appear to be in a productive condition in the watershed but some gully erosion and trampling in riparian areas has been observed.

Summary

Generally, undisturbed soils in the watershed are in a productive state that is associated with good watershed health. Recreation use, road construction and livestock use have the greatest potential impact on riparian and upland soils. Erosion from upland soils is occurring from naturally erodible geologic formations such as the Wayan Formation and intensive livestock and recreation use. Erosion potential is highest on soils that formed on the mountains and ridges. Mass instability occurs on many areas of the watershed although recent mass movements are few.

ISSUES AND KEY QUESTIONS

A variety of soil types occur within the analysis area. Sensitivity of these variations and protection of their integrity will minimize detrimental impacts. Resource management in the analysis area has the potential to improve current conditions or have detrimental affects.

1. Is the amount of ground cover that protects soils from erosion adequate to maintain stable soil conditions within the watershed?
2. Are riparian soils being adversely compacted/eroded from livestock grazing and dispersed camping?
3. Is livestock grazing causing erosion on upland sites and, if so, to what extent? Have past watershed protection efforts improved soil conditions?
4. Is recreation use adversely affecting soil productivity in the watershed?
5. What has been the effects on the soil resource from past burning from both wildfire and prescribed fire?
6. Have all areas that require watershed restoration been identified in the watershed and has there been a restoration plan developed for the watershed?
7. What is the extent and amount of landslides within the watershed?

CURRENT CONDITIONS

Data Sources:
- Caribou National Forest and Surrounding Area Sub-Regional Assessment for Properly Functioning Condition (USDA, 1997)
- Preliminary Landslide Study Eastern Caribou Forest (Olson, et al., 1970)
- Sediment reduction through watershed rehabilitation (Noble, 1963)
- Tepler field notes, 2002

Data Gaps
- Long-term erosion studies and ground cover studies
- Updated landslide inventory map
- Data base on prescribed burns and fires
- Long-term erosion studies on Palisades Reservoir shoreline erosion

Erosion

The amount of erosion occurring on the uplands in the watershed is directly related to the amount of protective ground cover found on a specific area. Ground cover on most undisturbed upland sites appears to be adequate to protect the soil from erosion. Natural erosion has occurred on soils that are droughty with low amounts of vegetation. Activities related to grazing have caused the most erosion in the watershed.

Areas of concern related to erosion caused by grazing use on upland slopes include sheep bed-grounds and driveways. Losses of topsoil have occurred because of the reduction in groundcover and compaction on these areas. Soil and rangeland improvements were identified during field investigations on the sheep driveways where many of these areas had been reseeded and others fenced (Tepler Notes, 2002) that have improved damage. Restoration from over grazing began in the late 50's with terracing and seeding of Big Elk Mountain and gully plugging Little Muddy Creek. Current ground cover measurements rate the effectiveness of this restoration as successful in controlling erosion. Little Elk Mountain has about 150 acres of soil eroding and in need of vegetation to increase ground cover. A gully plug installed in 2001 is controlling some sediment from entering Deadman Creek below and the scheduled reseeding should improve conditions. Impacts from the Bear Creek sheep driveway are lessening with the current 2 year rest rotation system and the reseeding done in the 80's. Watershed protection fencing on Fourth of July and Commissary Ridge have kept the sheep from the area but need more vegetation to improve soil quality. Gully plugs on Commissary Ridge are filling with sediment and losing effectiveness.

Ground Cover

Ground cover on most upland sites is protecting the soil from erosion. Recreation use and livestock grazing has caused the most disturbance to the vegetation portion of ground cover. Ground cover damage from over grazing has resulted in a shift in plant communities from mesic to xeric types and some areas have been invaded by conifer species (USDA 1997). On some sites wyethia (mule's ear) have become dominant providing good ground cover in the spring and early summer but later dries and withers leaving soils bare. Camping, Off-Highway Vehicle (OHV) pioneered trails have removed vegetation where they occur.

Edward L. Noble wrote in, Sediment Reduction Through Watershed Rehabilitation, that in the Intermountain West, a minimum of 60 to 70 percent ground cover is needed to effectively control surface runoff of water and erosion occasioned by torrential summer rainstorms. Ground cover measurement made at the head of North and South Forks of Bear Creek, Big Elk Mountain show these areas to be in good condition. Visual observations estimate ground cover at the mouth of the main fork of Bear Creek, North Fork of Bear Creek Trail, Pine Creek Trail, along Milk Creek and Red Ridge to also be in good condition. Small areas 1 to 2 acres in fair condition, 37 to 60% ground cover, were also observed.

Riparian Soils

Riparian soils occupy a small amount of the soil base in the Bear Creek watershed but are heavily used by people and animals. Some riparian cover types have disappeared because of this use. Water diversion, roads, grazing and trampling have been major causes of negative impacts on riparian ecosystems. These impacts include: lowering of water tables, erosion of stream channels, concentrated runoff and increased sediment from roads and changes in vegetation composition, according to the 1997 Properly Functioning Condition Assessment of the Caribou National Forest. Geology of the area also effects the nature of riparian soils. Riparian areas found on stable parent materials, such as limestone, are less erosive and therefore very resilient. Conversely, those found on unstable parent materials, such as the siltstone and mudstone of the Preuss Range, are more erosive and therefore much less resilient. Some riparian areas suffer from loss of soil-holding vegetation. Others have too much vegetation, interruption of historic patterns and several decades of reduced flows have led to cottonwood recruitment and many over mature Populus species on some sites (USDA, 1997).

There is 8.5 miles of riparian soils along the Palisades Reservoir being eroded by wave action. This is the largest area of accelerated erosion of riparian soils in the watershed with shorelines with up to 6 feet of exposed soil and under cut banks common. Attempts to control erosion at the Calamity boat launch include gabions built in the late 70's are reducing the amount of erosion there. The amount of soil eroding yearly along the shoreline is currently unknown. Calamity and Bear Creek Campground recreation areas make up the second largest disturbance. Soil impacts from developed recreation sites are mostly permanent. Vegetation is removed; soils are exposed, shaped and leveled, compacted; and surfaced with gravel, concrete or asphalt. Areas that are not surfaced, such as footpaths, tenting and picnicking areas, have exposed, compacted, puddled and eroded soils (National Soil Survey Handbook 1996,). Dispersed camping and grazing have effected small areas along the main fork of Bear Creek. These campsites are compacted, not revegetating and eroding. The grazed areas have trampled banks and suffer vegetation cover loss but are recovering. The hot spring located by the Warm

Spring trail, is a high use recreation area with compacted soils and lack of vegetation to slow erosion.

Recreation

Recreation use has impacted the watershed. Campgrounds, dispersed camping and trails have taken approximately 40 acres of soils out of productivity according to Brent Porter, Recreational Specialist for the Palisades Ranger District. The Calamity and Palisades Summer Home Areas add another 100 acres to this total. These soil impacts from developed recreation sites are mostly permanent (National Soil Survey Handbook 1996). There is 72 miles, approximately 26 acres, of trails motorized and non-motorized in the watershed. Trail impacts to soils are not limited to the appearance of a tire mark, but include compaction, decreased permeability to air and water, increased runoff, increased erosion, reduction in soil depth and organic matter and a decrease in vegetation density and productivity (Payne, et al, 1983, Snyder, et al, 1976, Weaver, et al, 1978). Increased erosion also reduces the productivity of the remaining soil. Belnap (1995) reported a reduction in soil nutrients as a result of off-road vehicle impacts in several ecosystems including mountain meadow and lodgepole pine. User created motorcycle trails have the most detrimental impact because of their tendency to be on very steep slopes. Soil impacts tend to be more severe at high elevations; on steeper slopes; and on wetter, poorly drained soils (Leung and Marion, 1996).

Landslides

In 1915 the U.S. Geological Survey first mapped landslides on this area but the scale of the maps was such that few were delineated. The geology and the weather combine to form circumstances that produce landslides. Cretaceous age rocks are the worst for landslide susceptibility. Cretaceous age rocks make up the majority of the outcrops in the area. These rocks are shales and other thin bedded siltstones, mudstones, sandstones, a few quarztites, limestones and conglomerates. Other rock units contribute to the problem by being steep (Olson and Moyle, 1969). Three landslides are delineated on the Caribou-Targhee National Forest's Geographic Information System (GIS). Indicators of past landslides can be seen along Red Ridge (Tepler notes, 2002).

Fire

Effective fire suppression over the last 50 to 80 years has interrupted fire regimes on portions of the watershed. The associated soils of shrublands, dry Douglas fir, and aspen communities are the most affected. Periodic fires on shrublands vary the mix of shrubs according to their ability to root sprout and shrubs versus grasses and forbs. Effective fire suppression alters nutrient cycling with less frequent nutrient inputs from burning and the interruption of the shift of vegetation favoring root sprouting shrubs, grasses and forbs (Knight 1994, Clark and Starkey 1990). The increase in erosion from natural wildfire in shrub communities is generally short-lived. Prescribed burning of shrubs on soils has been of limited extent, and generally of little negative impact to soils.

PAST CONDITIONS

Erosion

Natural processes of weathering, stream erosion, mass wasting, and glaciation all had a role in shaping the uplands of the Bear Creek watershed. Much of the geology of the area has high natural erosion rates and mass instability. Formations of mudstone and siltstone have eroded naturally over a long period of time. Basins are filled to some extent with alluvial material eroded from the surrounding mountain ranges (USDA-FS, 1990). This erosion (background erosion) combined with erosion from man-caused disturbances is the cumulative erosion regime for the Bear Creek watershed.

Variations in climatic conditions have also contributed to changes in the landscape and geomorphology of the watershed over time. Localized intense thunderstorms that often occur in the area sometimes cause severe soil erosion, especially on geologic formations that are unprotected. Historically, between 1880 and 1920, the western United States experienced more arid conditions with many heavy, erosive thunderstorms, and fewer, light, soaking showers. During the past few decades however, the climate in the west had changed, on average, to a cooler year-round climate with more precipitation.

Few roads and trails existed in the watershed prior to the early 1900's. Since that time, many trails, sheep driveways and roads have been pioneered or constructed near riparian areas and uplands that may have had an effect on watershed condition. Because roads have the greatest potential to create erosion and sediment, often the watershed condition can be directly related to the density of roads and trails, their location and maintenance in the watershed. Other disturbances (i.e. logging, grazing, mining and recreation) also play an important role in watershed condition. Areas of the Bear Creek watershed have declining watershed condition where these kinds of disturbances have removed natural vegetation and caused accelerated erosion.

Wildfires that remove protective cover from the soil surface have contributed to erosion on forest and rangelands in the past. Wildfires occurred in the past usually during regular return intervals with similar results that occur in the present. Both wildfires and prescribed fires have occurred within the watershed in the recent past.

Ground Cover

Ground cover within the watershed is assumed to have been adequate to protect the soils from erosion before livestock were introduced into the area. This assumption is made based on the amount of biomass currently consumed by livestock that would be historically left as ground litter. The first extensive use of the forage portion of ground cover was by cattle and horses. Beginning in 1836, thousands of people trailed through the Caribou area over the Oregon Trail. Sheep first appeared about 1883 when grazing began along the Snake River; by 1893 there were large numbers. The area now in the

Caribou National Forest was fully stocked by sheep by 1900, and overstocked by 1905(Ogle, 1997). Sheep outfits ranged on the foothills to the east of Rexburg and as far east as Thousand Springs Valley on the Targhee. By 1893 to 1895 the sheep were taken to the higher mountains for summer range. High elevations and ready availability of lush forage made it a very desirable area for sheep grazing. However, due to the steepness of the slopes, high altitudes and short growing season it also was very vulnerable to overuse. By 1896 range deterioration was noticeable. Grasses were replacing the bluebells, broadleaf, and better forage plants. At the peak of stocking (1896-98), considerable erosion was evident. Livestock driveways, such as the Bear Creek Driveway, and bed grounds showed excessive erosion. Edward Noble reported, in Chaparral Hollow topsoil losses have been high as evidenced by 6 to 8 inch high hummocks remaining under some surviving perennial plants (Noble, 1979). Ranger James L. Jacobs recorded in his 1938 grazing report, “Gully erosion is gaining rapidly on the steep slopes of Big Elk Mountain. Gullies more than 20 feet deep were made in several of the canyons on Elk Mountain this summer” (Elk Mountain Watershed Project, 1958).

Riparian Soils

Riparian areas and wetlands had less impact from trampling and grazing before the introduction of livestock.

Recreation

Impacts from recreation were limited to pioneered trails used by trappers, hunters and fisherman.

Landslides

The U.S. Geological Survey first identified landslides on this area in 1915. The geology and weather combine to form circumstances that produce landslides. Cretaceous age rock outcrops are the most susceptible to landslides. These rocks are shales and other thin bedded siltstones, mudstones, sandstones, a few quartzites, limestones and conglomerates. These rocks have been warped or bent into anticlines and synclines typically one and one-half miles apart. High angle faults and thrust faults have also contributed to the problem (Olson and Moyle, 1969). Other rock units contribute to the problem by being steep. Although much of the watershed has unstable geologic formations, few recent landslides are evident. Most of the past mass movements have occurred in the form of rapid debris slides or debris avalanches.

Fire

Fire was an important disturbance to vegetative ground cover. It influenced the mix of shrubs according to their response to burning and also the relative proportions of shrubs to grasses and forbs, for at least 20+ years. Burning released nutrients to the soils and after fires the amounts of organic matter inputs generally increased as grasses and forbs increased (Knight 1994, Blaisdell et al 1982). Fires that started or were carried up into aspen could kill succeeding conifers and stimulate regeneration of the aspen clones if conditions were right. Detrimental soil impacts were generally short lived. Fires that burned in the higher, cooler and wetter Douglas fir, subalpine fire and lodgepole pine forests were not as common. Fires in hot, dry years could burn intensely enough to be stand replacing. Fires that were ignited in more normal years were typically of small extent and low intensity. Soil impacts from these events were generally short lived. Fires that burned in the drier Douglas fir communities were often of lower intensity and frequent with minimal impacts to soils. Hot, stand-replacing fires in the drier Douglas fir would impact soils similarly to stand replacing fires in higher, cooler conifer stands.

TRENDS

Erosion

Although accelerated erosion continues to occur on some areas of the watershed; Palisades Reservoir shoreline, off-road vehicle pioneered trails and roads, sheep bed-grounds and driveways, restoration and management practices are stabilizing and/or improving vegetation conditions that help protect soils from erosion.

Ground Cover

The downward trend in vegetative ground cover from the early 1900s when sheep were overstocked is stabilizing or slowly reversing with the reduction in numbers of sheep in the watershed. Improved range management, seeding bare soils, exclosure fencing have allowed vegetation to recover reducing the amount of erosion. Big Elk Mountain is an example of the trend. Where soils were once bare and seriously eroding now good ground cover grows. Although some plant communities have changed slowly, areas of concern are stabilizing or improving.

Riparian Soils

Riparian soils as a whole are in a static condition. While some areas improve others continue to degrade. Management efforts to reduce the effects of livestock are succeeding. Creek banks are stabilizing and vegetation is returning, albeit slowly, to its pre-livestock condition. In the opposite direction dispersed camping and trails in the riparian zones continue to impact soils through erosion and compaction. The creation of Palisades Reservoir has had the most impact on riparian soils. Shorelines and the mouths of streams are eroding into the reservoir with wave action natural and manmade.

Recreation

Recreational impacts in the watershed have increased dramatically from the early 1900s. Permanent campgrounds, dispersed camping, OHV use have compacted and eroded soils in both upland and riparian areas. Pioneered trails are continually being made. Increasing populations and easy of access with OHVs will continue this trend.

Landslides

Few landslides have been initially identified within the watershed. No mass failures in the watershed have been identified as a result of management activities except for small cut-slope failures associated with road construction. Climate is the primary factor that determines the occurrence of landslides in a natural setting. Natural landslides will continue to occur on these areas when climatic conditions cause the surface mantle to become saturated with water, combined with slope stability factors of gravity and surface friction.

RECOMMENDATIONS

Listed in order of importance

Restoration/Protection for Improving Soil Conditions

1. Improve fence exclosure areas in Chaparral Hollow and Commissary Ridge by scarifying soil, seeding and mulching. Continue to restore deteriorated rangelands through soil and water improvement projects.

2. Close and (where appropriate) obliterate roads and trails that are not on the transportation system map. Using road analysis, identify unnecessary roads and trails that are poorly/improperly designed/maintained, are causing ecological problems and continue to erode. Relocate and redesign system roads and trails that are chronic erosion/sediment producers.

3. Restrict recreation use along riparian corridors, where possible, to improve riparian conditions.

4. Many areas with big mountain sagebrush appear to be suitable for prescribed fire treatments that could be applied to improve age class diversity and improve vigor in the understory. These kinds of treatments usually have a positive effect on ground cover in the following years after treatments occur showing measurable decrease in erosion.

4. Historical areas of aspen with conifer encroachment sagebrush appear to be suitable for prescribed fire treatments that could be applied to improve age class diversity, regeneration, retard conifers and improve vigor in the understory. These areas are typically where soils have a mollic epipedon. These kinds of treatments usually have a positive effect on soils.

5. Limit off-road travel and user-created trails and roads.

6. Improve camping sites and provide an area for horses at the Hot Springs to reduce erosion and limit expansion of sites.

7. Update range allotment Annual Operating Instructions to improve livestock management in riparian areas. Ensure soil quality standards are followed in riparian areas to avoid detrimentally compacted soils. Installation of riparian pastures and additional exclosures should be considered to reduce impacts on wetlands and riparian areas.

8. Strive to achieve properly functioning conditions for ecological types in the watershed by applying vegetation treatments that are ecologically sound.

Inventory and Monitoring Soil Conditions

1. Soil and water improvement projects should be identified in a watershed improvement plan. The plan should include specific projects related to recreation and grazing management and treatments required to improve or maintain soil and watershed resources.

2. Establish erosion monitoring program for management activities related to grazing.

3. Establish monitoring program for ground cover on a variety of ecological sites by establishing nested frequency transects.

4. Establish monitoring program for landslide occurrences to determine if they were caused by management actions.

5. Establish monitoring program for shoreline erosion/protection on Palisades Reservoir.

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